THE IMPLEMENTATION OF TECHNOLOGY EDUCATION: INTRINSIC AND EXTRINSIC CHALLENGES FOR QUEENSLAND TEACHERS.

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Abstract:
With the release of the Technology Years 1 to 10 Syllabus and associated curriculum materials by the Queensland Studies Authority in 2003, Education Queensland announced that all Queensland government schools were to aim for full implementation by 2007. This paper reports the findings of an investigation into the intrinsic and extrinsic challenges experienced by teachers during the implementation of Technology Education. Student and teacher interviews, observations, artefact collection using digital photographs, and the administration of the Technology Syllabus Implementation Questionnaire (TSIQ) were undertaken to develop case studies. The major findings of this study included the identification of intrinsic challenges being professional knowledge and understanding, teacher confidence in the teaching of technology, attitudes and values of the Technology key learning area, and approaches to teaching. Extrinsic challenges included a lack of resources and time, varying methods of student assessment, the practicality of the implementation of a new curriculum area, and the quality of professional development programs. From the challenges identified, suggestions are made to inform the future implementation of Technology Education.

Introduction
Curriculum innovation and curriculum reform endeavour to enhance the quality of learning, however, the intended innovation is often different from the actual innovation that is implemented in the classroom (Treagust & Rennie, 1993; Rennie et al., 2001). Technology is a relatively new Key Learning Area (KLA) within Queensland schools, with the official release of the Technology Years 1 to 10 Syllabus (QSA, 2003a) and associated curriculum materials during 2003. Accompanying the official launch of this new set of curriculum documents, the Queensland Government announced that all Queensland schools were to aim for full implementation of the new Technology Key Learning Area (KLA) by 2007. This presents challenges for Queensland teachers in primary schools as they become required to understand and implement this new KLA within their classrooms.

The introduction of the new Technology KLA involves the implementation of a new curriculum, where the intended curriculum refers to the syllabus and accompanying curriculum materials. The implemented curriculum refers to ways in which classroom teachers deliver the new curriculum into their teaching program (Treagust & Rennie, 1993). As teachers are the primary implementers of new curricular, teacher acceptance of change (Carless, 1997; Rennie et al., 2001; Sade & Coll, 2003), and a high level of teacher commitment, are crucial to successful implementation (Rennie, 2001; Sade & Coll, 2003). However, research indicates that teachers are rarely receptive to change (Sade & Coll, 2003). During times of change and reform, the challenges that teachers are presented with are widely recognised (Carless, 1997). The implementation of technology education is no
exception to these challenges (Raizen, 1997; Compton & Jones, 1998; Lloyd, 1999; Stein, McRobbie & Ginns, 2000; Mawson, 2003; Merrill, 2004).

Education Queensland released a number of different strategies that were designed to assist the implementation of technology education, including research partnerships with universities. Thus a partnership project between Education Queensland and Griffith University, *Researching School Change in Technology Education* (RSCTE), began undertaking implementation research within three schools on the Gold Coast, located in the South-East region of Queensland, Australia. This study was embedded within the RSCTE project, and aimed to specifically investigate the challenges that classroom teachers encountered during the implementation of the Technology KLA in primary classrooms.

As suggested by Lewthwaite and Fisher (2004), implementation challenges can be divided into two categories, intrinsic challenges and extrinsic challenges. For example, intrinsic challenges refer to challenges that teachers may face on a personal level, such as teacher knowledge and understandings of the intended curriculum (Lewthwaite & Fisher, 2004). Extrinsic challenges are external or environmental factors that may impede the implementation process, such as insufficient resources and/or a lack of professional development (Lewthwaite & Fisher, 2004). Thus, the central research questions guiding this study were identified as:

(a) What intrinsic challenges arise during the implementation process of the Technology KLA for Queensland teachers?
(b) What extrinsic challenges arise during the implementation process of the Technology KLA for Queensland teachers?
(c) What suggestions can be made to inform the future implementation of the *Technology Years 1 to 10 Syllabus*?

**Queensland technology years 1 to 10 curriculum materials**

The former Queensland School Curriculum Council (QSCC) began developing the first Queensland technology syllabus in 1998. This process involved many trial and pilot phases (Finger, Jamieson-Proctor & Houguet, 2004), until the Queensland Studies Authority (QSA) released the *Years 1 to 10 Technology Syllabus* (QSA, 2003a) during 2003 (Finger, Jamieson-Proctor & Houguet, 2005). Education Queensland has allocated more than three years for schools to implement this syllabus within their curricula, announcing “all schools should have a curriculum program for Technology in place for full implementation by the start of the 2007 school year” (Education Queensland, 2003a). As technology education has not previously been identified as a KLA in Queensland schools, this will present many challenges for classroom teachers as they plan, implement and evaluate technology units for the first time (Stein et al., 2001; Finger, Adams-Jones & Vickers, 2002).

With the release of the *Technology Years 1 to 10 Syllabus* (QSA, 2003a), QSA developed and released a suite of associated curriculum materials which can be found on the *Technology Years 1 to 10 Curriculum Materials (CD-ROM)* (QSA, 2003b). It is essential for teachers and researchers to develop a thorough understanding of the technology syllabus to gauge whether the progress from intention to implementation of the technology KLA is successful (Finger, Jamieson-Proctor & Houguet, 2004), and to adequately measure the challenges that may arise during this process.
Literature review

Table 1 provides a synthesis of teacher intrinsic challenges, while Table 2 provides a synthesis of extrinsic challenges experienced by teachers during the implementation of technology education.

Table 1: Intrinsic challenges for technology education curriculum implementation – a synthesis of the literature

<table>
<thead>
<tr>
<th>ISSUES AND LITERATURE SOURCE</th>
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<tbody>
<tr>
<td>Professional knowledge and understanding</td>
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<tr>
<td>• Diversity amongst teacher knowledge and understanding (Sade &amp; Coll, 2003)</td>
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<tr>
<td>• Level of teacher knowledge and understanding has generally been found to be limited (Lloyd, 1999; Stein et al., 2001; Jones et al., 2004)</td>
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<tr>
<td>• Classification of teacher knowledge; subject matter knowledge, curricular knowledge, pedagogical content knowledge, school knowledge, and personal constructs (Stein, Ginns &amp; McRobbie, 2002, based upon Banks, 1996).</td>
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<tr>
<td>Professional adequacy</td>
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<tr>
<td>• Level of confidence that teachers have in their ability to implement the intended curriculum (Lewthwaite &amp; Fisher, 2004).</td>
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<td>• Confidence is directly associated with their level of knowledge and understanding of technology and technology education (Stein et al., 2000).</td>
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<td>• Trend in professional adequacy with the majority of teachers feeling apprehensive in their abilities to implement technology (Stables, 1997; Rennie, 2001).</td>
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<td>• As technology education is a new KLA, teachers feel unsure and nervous about its implementation (Rennie, 2001).</td>
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<td>• Need for teachers to develop high levels of professional adequacy regarding technology education (Compton &amp; Jones, 1998; Jones et al., 2004).</td>
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<td>Professional attitudes and values</td>
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<td>• Teacher attitudes towards and values of the intended curriculum (Lewthwaite &amp; Fisher, 2004) are significant factors contributing to the implementation process (Carless, 1997).</td>
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<td>• Teacher beliefs are the least susceptible to change of all implementation participants (Carless, 1997; Rennie et al., 2001).</td>
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<td>• Teachers feel that change brings about more problems than solutions (Sade &amp; Coll, 2003).</td>
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<td>• Negative attitudes toward technology education have been attributed to hefty workloads (Rennie, 2001; Stein et al., 2004).</td>
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<td>• A period of adjustment to allow teachers to gain experience in technology education is required (Treagust &amp; Rennie, 1993; Rennie, 2001).</td>
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<td>Teaching approach</td>
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<td>• Reluctance to adapt teaching approaches will inhibit successful implementation of technology education (Rennie, 2001).</td>
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<td>• Need to be flexible and able to modify teaching approaches to reflect the needs of students and the innovation to be implemented (Stein et al., 2000).</td>
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<tr>
<td>Ownership</td>
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<td>• The higher the level of teacher ownership over new curricular the more likely the implementation process will be successful (Carless, 1997).</td>
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<td>• Teachers require time to accept ownership (Treagust &amp; Rennie, 1993).</td>
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<td>• The application of top-down and bottom-up strategies simultaneously will provide the best opportunity for successful curriculum implementation (Carless, 1997; Rennie, 2001).</td>
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Table 2: Extrinsic challenges for technology education curriculum implementation – a synthesis of the literature

<table>
<thead>
<tr>
<th>ISSUES AND LITERATURE SOURCE</th>
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<tr>
<td>Resources</td>
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<tr>
<td>• Innovations require adequate resources to ensure successful implementation (Carless, 1997; Lewthwaite &amp; Fisher, 2004).</td>
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<tr>
<td>• Teacher and student resources have been found to be limited (Stables, 1997; Rennie, 2001; Jones et al., 2004).</td>
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<tr>
<td>• Efficient resource management (Lewthwaite &amp; Fisher, 2004).</td>
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<td>• Implementation requires a variety of resources including human, material and monetary resources (Carless, 1997; Rennie et al., 2001; Jones et al., 2004).</td>
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<td>• Human resources are required for professional development and to allow more time for familiarisation and planning (Carless, 1997).</td>
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<tr>
<td>Time management</td>
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<td>• Most important teacher resource is time (Treagust &amp; Rennie, 1993; Stein et al., 2000).</td>
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<td>• Concerns for teachers are time availability and time management (Stein et al., 2000, 2001; Rennie, 2001; Lewthwaite &amp; Fisher, 2004).</td>
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<td>• Implementation requires time for teachers to familiarise themselves with technology and technology education (Lewthwaite &amp; Fisher, 2004), obtain adequate resources, plan and prepare technological activities, implement and reflect on those activities (Treagust &amp; Rennie, 1993; Rennie et al., 2001; Lewthwaite &amp; Fisher, 2004), and to observe other technology units (Rennie, 2001).</td>
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<td>• Controversially, when time has been provided for teachers during implementation, limited time was an excuse used by those uncommitted to change (Rennie, 2001).</td>
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Practicality of Implementation

- Practicality of a new curriculum influences the desires and motivations of teachers to implement (Carless, 1997).
- Determined to a large extent by the compatibility of the new curriculum to existing classroom practices (Carless, 1997).
- A major concern for teachers is that the primary curriculum is already at its full capacity (Stables, 1997; Jones et al., 2004).
- Teachers are apprehensive about how technology can be incorporated into such a “crowded curriculum” (Stein et al., 2001; Jones et al., 2004).
- Teachers have attempted to overcome this challenge by integrating technology with other curriculum areas (Stein et al., 2001; Jones et al., 2004).
- School culture plays an important role in the implementation of new curriculum (Compton & Jones, 1998).
- Technology education should be implemented on a school-wide basis to ensure its implementation is practical (Treagust & Rennie, 1993).

Student Assessment

- Assessment is essential in evaluating the overall success of technology units (Rennie et al., 2001).
- Finding suitable methods for student assessment (Stein et al., 2001; Jones et al., 2004).
- In NZ, most common forms of assessment include practical tasks, observations and consultation with students (Jones et al., 2004).

History and Tradition

- Technology education is still being invented (Raizen, 1997), and lacks both history and tradition (Raizen, 1997; Compton & Jones, 1998; Stein et al., 2000; Rennie, 2001; Sade & Coll, 2003).
- As a new KLA, there are few established beliefs, values and pedagogical practices (Raizen, 1997).
- Teachers lack the experience and knowledge required to implement technology in the classroom (Stein et al., 2000; Rennie, 2001).

Professional Development and Support

- Requires large-scale professional development (Stables, 1997; Compton & Jones, 1998; Rennie, 2001).
- Inadequate professional development has been provided for the implementation of technology education (Stables, 1997; Stein et al., 2000; Rennie, 2001; Jones et al., 2004).
- Need for further and ongoing professional development (Compton & Jones, 1998; Jones et al., 2004).
- May involve teacher collaboration, which benefits curriculum implementation (Lloyd, 1999; Stein et al., 2000; Rennie, 2001).
- Within teams teachers can provide necessary support to aid implementation (Rennie, 2001).

Research design

This project was focused around the development of case studies, which are in depth studies that focus on one subject and are set within real life contexts (Knobel & Lankshear, 1999). Case studies allow readers to make comparisons with their own experiences, and “transfer understanding and apply findings from this study to his or her own context or situation” (Knobel & Lankshear, 1999, p. 96). In this study, multiple case studies were developed for comparative purposes, and examined the teacher intrinsic and extrinsic challenges that occurred during the implementation of the identified technology units. The methodologies for data collection utilised within this study included teacher and student interviews, observations, and artefact collection in the form of digital photographs. A further methodology utilised was the Technology Syllabus Implementation Questionnaire (TSIQ), a questionnaire adapted by Ginns, McRobbie, Norton and Davis (2004) from the science curriculum implementation questionnaire developed by Lewthwaite (2004).

Findings

This paper provides two case studies which summarise the technological experiences of two of the teachers studied, and provides an overview of the intrinsic and extrinsic challenges that occurred during the implementation of technology units of work. Subsequently, strategies for addressing these challenges during the implementation of technology education are presented.

Case Study 1: Celebrating With Food

Name of Teacher: Larry  Year Level: 2
**Design Challenge:** Your task is to conduct a class restaurant where you are to design for, prepare for and serve your parents a luncheon.

**Teacher Intrinsic Challenges**

**Professional Knowledge and Understanding:** Larry has been teaching for five years, and although Larry’s tertiary education alerted him that technology curriculum documents would be released, he did not receive any formal training in this curriculum area before graduation. Larry’s current knowledge of technology and technology education has been founded upon activities within the RSCTE project, including discussions at staff meetings, collaboration with project researchers, and collaboration with other staff members. Before Larry’s involvement with the RSCTE project, his views and understanding of technology education were quite different to his current perception. He believed that technology referred to “computers and things electrical”, and commented that he was “not seeing (technology) as a design process” (Larry, 22nd November 2004). His involvement in the RSCTE project assisted him by “opening (his) mind to what technology really is” (Larry, 22nd November 2004).

**Professional Adequacy:** Professional adequacy was an intrinsic challenge identified through Larry’s responses to the TSIQ instrument suggesting that, while Larry’s confidence in his ability to teach technology is not extremely high, he is gaining confidence to implement this KLA in his classroom. Larry indicated that he feels “a lot more confident than at the start of (his) career” (Larry, 22nd November 2004) in teaching this KLA.

**Teacher Extrinsic Challenges**

**Resources:** An extrinsic challenge experienced by Larry during the implementation of this unit was a lack of resources. This is evident in the comment “sometimes you are limited in your resources, especially when working in a team of teachers where there are four classes doing the same activities” (Larry, 22nd November 2004).

**Time:** Another extrinsic challenge experienced by Larry during technology implementation was a lack of time. The identification of this challenge became evident through the TSIQ instrument, where Larry’s response to item 34: - I believe that there is adequate time in the overall school curriculum to teach technology - was ‘Disagree’. Larry also agreed to item 20: - My technology teaching suffers because the overall school curriculum is crowded.

**Unit Reflections**

“You learn from your mistakes” (Larry, 22nd November 2004). This comment made by the classroom teacher was referring to students during their involvement in their design challenges. As summarised by the classroom teacher, “even though there are many challenges involved, there are ways of getting around them by modification” (Larry, 22nd November 2004).

**Case Study 2: Youth Culture and Identity**

**Name of Teacher:** Bill  
**Year Level:** 7

**Design Challenge:** The Gold Coast City Council has been granted $2 million to build a youth centre somewhere on the Gold Coast. As one of the fastest growing areas, it has been selected as the site for this development and the council has asked the local schools to submit their designs for this centre. In groups of two, you are to research the essential features that a modern youth centre would contain and include these (and any other features that you believe would be viable) into a scale plan (including dimensions and labels) of the youth centre that you would like to see constructed in your local community. So that the members of the wider community can also visualise what your centre will look like, you are to develop a three-dimensional model of your centre using Pro-Desktop.

**Teacher Background:**
Bill had been teaching for 11 months during the implementation of this technology unit, with this being his first teaching position after graduating from university. Bill is employed as a specialist teacher in Industrial Design and Technology (IDT) which involves teaching students from years 7 to 9. Although Bill’s position requires him to teach from the Queensland IDT syllabus, he incorporates outcomes from the *Technology Years 1 to 10 Syllabus* within his teaching units, especially for Year 7 students. Bill believes that the IDT syllabus “readily fosters the technology syllabus requirements” (Bill, 14th April 2005). As Bill is a recent graduate his knowledge and understanding of technology and technology education was well developed.

**Teacher Intrinsic Challenges**

Teaching Approach: Bill’s experiences as an IDT specialist involve teaching students industrial skills. Bill finds that teaching students these skills takes time, therefore the design element is sometimes forgotten in order to teach these skills. This was also evident within this unit, as the students were not familiar with the computer program, Pro-desktop. Students required assistance to use the program, and were shown methods to create their youth centre using templates, and as a result, this reduced the design scope of the unit.

**Teacher Extrinsic Challenges**

**Professional Development and Support:** Although Bill has attended in-service in the technology KLA, he feels that this has not adequately covered implementation and assessment strategies. He expresses the need for professional development opportunities that provide “practical examples that work” (Bill, 22nd November 2004). Bill also expresses the need for further collegial support during the implementation of technology education. As Bill is the IDT specialist within Stage C at UCSC, he is responsible for the implementation of technology within this stage, commenting that the “technology component is left up to me” (Bill, 22nd November 2004). This lack of support is also emphasised in the comment “middle school does not recognise the importance of technology education in general” (Bill, 14th April 2005).

**Time:** Bill suggests that students need to be taught basic skills, although he realises that it “takes a lot of time to teach these skills”, and that “the syllabus doesn’t allow for these skills” (Bill, 22nd November 2004). As this technology unit was taught within specialist time, i.e. one hour a week for nine weeks, Bill identified a challenge as maintaining a “timeline and getting things done” (Bill, 22nd November 2004).

**Resources:** Bill identified a challenge throughout this unit as “not having enough computers that work” (Bill, 22nd November 2004), which was essential for students to complete the design challenge of the unit. Although Bill identified this as a challenge in his interview, his responses to the TSIQ instrument did not reveal that resource adequacy presented a challenge throughout the unit. The resources used presented a challenge for the students. Students had difficulty in “using the program” (Student, 22nd November 2004), and required assistance to complete tasks using Pro-desktop.

**Unit Reflections**

Bill feels confident in his ability to teach technology education. In reflecting upon the implementation of technology education within his classroom, he feels as though he is “constantly learning through mistakes” (Bill, 22nd November 2004).

**Suggestions for implementation**

Table 3 presents suggestions that might assist in addressing intrinsic challenges experienced by teachers, while Table 4 presents suggestions that may prevent or reduce extrinsic challenges experienced by teachers during the implementation of technology education.
Table 3: Suggestions for addressing intrinsic challenges experienced by teachers during the implementation of technology education

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<tr>
<th>INTRINSIC CHALLENGES</th>
<th>SUGGESTIONS FOR IMPLEMENTATION</th>
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| **Professional Knowledge and Understanding** | • Provide a copy of the *Technology Years 1 to 10 Syllabus* to all Queensland teachers rather than placing copies within school libraries where it is the responsibility of teachers to access these documents.  
• Conduct regular professional development activities within schools that require close examination of the curriculum materials. These activities should be conducted cooperatively between school administration, Education Queensland and researchers.  
• Provide examples of successful technology units for teachers. These examples should be available in a wide range of media, eg. DVD, video, photographs, CD-ROM, and written materials. These should also be made available on the QSA website.  
• Invite international, interstate, state or district teachers who are confident in their ability to teach technology education to share their experiences in the technology KLA.  
• Develop school-based folios of technology units. These folios can then be shared with schools throughout the district and throughout the state.  
• Conduct workshops that require teachers to develop strategies for specific components of technology education eg. Planning, group management, resources, and assessment.  
• Establish networks where teachers can contact Education Queensland representatives and/or researchers to clarify understandings of technology education. |
| **Professional Adequacy** | • Establish support networks within schools and within districts where teachers can share technology experiences.  
• Conduct cluster meetings where teachers can discuss successes and challenges and provide advice to others.  
• Ensure there is continual support and encouragement for teachers from school administration.  
• Allow time for teachers to feel comfortable with the idea of technology and become submerged in ideas and examples prior to and during implementation.  
• Allow time for teachers to implement and experiment with a number of different technology units. |
| **Professional Attitudes and Values** | • Set a design challenge for teachers to solve, ensuring the challenge is fun and meets teacher needs. This will allow teachers to experience the technological processes that are required to complete a design challenge, and will assist them to recognise the depth of student learning and enjoyment that can be achieved.  
• Conduct a student technology exhibition, where students display and discuss their designs with teachers, family and friends.  
• Provide design challenges that require students to solve problems that are relevant to their school and community.  
• Provide a technology unit example to teachers and assist them to dissect this unit to identify how it allows student learning within a variety of KLA’s.  
• Invite students who have participated in a design challenge to share with teachers the enjoyment and experiences they gained from the unit.  
• Ensure school administration recognises the importance of technology and reflects this within school policies and practices. |
| **Teaching Approach** | • Provide many examples for teachers so they become familiar with the teaching approach required for technology.  
• Assist teachers to make an easy transition between teaching approaches through advice, encouragement, support and time. |

Table 4: Suggestions for addressing extrinsic challenges experienced by teachers during the implementation of technology education

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<tr>
<th>EXTRINSIC CHALLENGE</th>
<th>SUGGESTIONS FOR IMPLEMENTATION</th>
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| **Resources** | • Develop a school-based folio of technology units, which can be shared with other schools.  
• Ensure a proportion of school and classroom budgets are allocated towards the purchase of technology resources and materials.  
• Develop a technology resource centre within schools, where teachers and students can bring materials from home that they no longer need and that might become useful in technological activities.  
• Consult business and community groups that may donate materials, ensuring that the appreciation of their generosity will be expressed in the school newsletter. |
**Conclusion**

As identified by Jones, Harlow and Cowie (2004), a study conducted within New Zealand schools three years after the implementation of technology education revealed that teachers still had little understanding of technology. These teachers also indicated the need for further professional development programs during and after the implementation process. This indicates the importance of continued research within the field of technology education during and beyond the initial phases of implementation. The challenges experienced by teachers during implementation may differ to challenges they experience over time; therefore a similar future study may be beneficial for identifying such challenges. This study has revealed teacher intrinsic and extrinsic challenges associated with the implementation of technology education, and has presented suggestions to address these challenges. As Queensland teachers are currently involved in the implementation of technology education, the findings presented in this study aim to assist teachers during this time, and aim to aid the implementation of technology education as it is intended in the Technology Years 1 to 10 Syllabus. Furthermore, the intrinsic and extrinsic challenges identified within this paper may be compared and analysed by teachers implementing technology within any situational context, and implementation suggestions may be utilised or built upon to aid this implementation.

**References**


